

## A survey of current practice of difficult airway management and equipment in pediatric anesthesia

Difficult airway in pediatric anesthesia

Derya Karasu, Canan Yilmaz, Seyda E. Ozgunay, Umran Karaca  
Anesthesiology and Reanimation, Health Sciences University Bursa Yuksek Ihtisas Training and Research Hospital, Bursa, Turkey

### Abstract

**Aim:** Airway management is one of the key areas of pediatric anesthesia practice. In this study, we aimed to investigate the availability of equipment for difficult airways in pediatric anesthesia and to increase the awareness on the subject among anesthesiologists. **Material and Method:** The survey was carried out using the forms.google.com. Our questionnaire was forwarded to the members on the internet by the Turkish Society of Anesthesiology and Reanimation. Anesthesiologists working in Turkey and willing to join the survey were included in the study. **Results:** The mean age of the 390 participants who completed our questionnaire was 39.40±7.26 years. The majority (34.6%) of the participants were working for training and research hospitals; 35.4% had been working for 1-5 years; 53.1% had attended a training course on airway management. The frequency of pediatric anesthesia every day was 32.8% and 46% of the participants had been administering pediatric anesthesia to few pediatric patients each week. A special kit of equipment for difficult airway management was available to 35.4%. The classical LMA was most frequently used equipment (95.6%). While 40.8% of the participants had encountered difficult airway in 1-5 pediatric patients, 7.9% also had the previous experience of an emergency surgical airway. **Discussion:** Our study has determined that the incidence of emergency surgical airway experience was low despite the high risk of encountering difficult airway management in pediatric anesthesiology. We believe that the success rates in difficult airway management would be increased by starting training courses with frequent periodicity on pediatric difficult airway management at different centers in our country, by widening the availability of required equipment and by increasing experience.

### Keywords

Airway Devices; Devices; Difficult; General Anesthesia; Education

DOI: 10.4328/ACAM.6160 Received: 14.01.2019 Accepted: 04.02.2019 Published Online: 11.02.2019 Printed:01.07.2019 AnnClinAnalMed2019;10(4):445-8  
Corresponding Author: Derya Karasu, Department of Anesthesiology and Reanimation, Health Sciences University Bursa Yuksek Ihtisas Training and Research Hospital, Mimar Sinan Street Yildirim Bursa, 16290, Turkey. GSM: +905057281175 E-Mail: drderyatopuz@gmail.com  
ORCID ID: <https://orcid.org/0000-0003-1867-9018>

## Introduction

Airway management is one of the key areas of anesthesia practice, it is also important for pediatric anesthesia. Because of anatomical differences, children are more prone to upper airway obstruction under anesthesia than adults. Also, children have a much higher oxygen consumption than adults, and as a result when they have airway obstruction or when they become apnoeic, hypoxemia develops much faster [1,2]. It has long been known that respiratory adverse events are the most encountered problem of perioperative critical events in pediatric patients [1,2]. Current guidelines addressing the difficult airway management in adults provide anesthesiologists a framework for managing the airway. Whereas in children, it is more difficult to establish guidelines due to fewer management options, failed airway management is less common, and recommendations would vary based on growth and development [3,4]. Supraglottic airway devices (SAD) inspired a fundamental change in the management of the difficult airway and are a key part of adult and pediatric difficult airway algorithms [5]. Use of SAD may reduce morbidity and in some cases be life-saving when used correctly and timely.

There is a little proof to determine the safest or most effective device to use for airway management. In addition, in difficult pediatric airway management, many of the adverse events occur frequently with unskilled personnel and insufficient resources available to respond to an unexpected crisis, often resulting in a worse outcome [6].

An unexpected pediatric difficult airway can lead to significant morbidity and mortality. Standardized emergency airway equipment should be available to prevent the adverse events related to a difficult airway. The aim of this study was to investigate the availability of difficult airway equipment in pediatric anesthesia in Turkey and to raise awareness on this subject among anesthesiologists.

## Material and Method

The local ethics committee (Uludag University Ethics Committee Number: 2018-3/15) approved this study. Anesthesiologists who were working in Turkey and willing to participate were enrolled in this study. A survey approved by the Turkish Society of Anesthesiology and Reanimation was distributed using *forms.google.com*, among all members from Turkey.

All statistical analyses were performed using the IBM SPSS ver. 21.0 software package. While numeric variables were expressed as mean  $\pm$  standard deviation, categorical variables were expressed in numbers and percentages. The Pearson's Chi-Square and Fisher's exact test were used to detect differences between groups of categorical variables. To determine risk factors binary logistic regression analysis was performed. A p-value < 0.05 was considered as statistically significant.

## Results

A total of 390 participants were involved in the statistical analysis. Table 1 shows the demographic data of the participants. The study revealed that overall incidence of attendance among the participants to courses on the subject of respiratory airways was 53.1% (n=207); these being 62.9% in state universities, 54.8% in training and research hospitals, 50% in private hospitals, 47.7% in state hospitals and 44.4% in private universities. Overall attendance to adult type courses was 40.3% (n=157), to pediatric type courses was 14.6% (n=57), and to courses in other countries was 1.3% (n=5).

The experience of access to the equipment for difficult airways and using it is shown in Table 2. In this study, the classical laryngeal mask airway (LMA) was found to be the predominantly used equipment (95.6%) on which most experiences were based. The specially prepared kit of difficult airways equipment was available to 35.4% of the participants.

When the presence of a specially prepared kit was investigated on the basis of the hospital type, significant differences were found (p=0.030). Availability of specially prepared kit was noticed in state universities (44.3%), in training and research hospitals (41.5%), in state hospitals (28.5%), in private hospitals (28.3%), and in private universities 11.1%. There was also a significant relationship between the specially prepared kit and

Table 1. Demographic details of participants (n=390)

Characteristics	n (%)
Age, year	39.40 $\pm$ 7.26 (26-75)
• 25-35 years	131 (33.6)
• 36-45	190 (48.7)
• 46-55	57 (14.6)
• >55	12 (3.1)
Gender	
• Male	132 (33.8)
• Female	258 (66.2)
Working	
• State University Hospital	70 (17.9)
• Training and Research Hospital	135 (34.6)
• Private University Hospital	9 (2.3)
• State Hospital	130 (33.3)
• Private Hospital	46 (11.8)
Experience in anesthesia	
• 1-5 years	138 (35.4)
• 6-10 years	115 (29.5)
• 10-15 years	69 (17.7)
• > 15 years	68 (17.4)
Frequency of pediatric cases	
• Daily	128 (32.8)
• Several cases per week	181 (46.4)
• A few cases per month	70 (17.9)
• No pediatric cases	11 (2.8)
Pediatric age range in practice	
• 0-1 month	67 (17.2)
• 1-11 month	153 (39.2)
• 1-3 years	243 (62.3)
• 4-5 years	265 (67.9)
• 6-10 years	164 (42.1)
• >10 years	54 (13.8)

Table 2. Availability and experience of equipment for pediatric anesthesia

Equipment	Availability %	Experience %
McCoy laryngoscope	36.7	41
Miller laryngoscope	65.9	67.4
Classical LMA	95.6	98.72
Pro-seal LMA	48.5	54.6
I-gel LMA	46.9	53.3
FastTrack LMA	9.2	15.9
Video laryngoscope	35.6	49.7
Fiber-optic bronchoscope	30.3	27.9
Optical stile	12.1	11.8
Jet ventilator	2.8	4.4
Retrograde intubation equipment	4.9	4.4
Cricothyroidotomy kit	20.5	10.8
Combitube	14.6	15.4
Laryngeal tube	12.8	9.2
Easy laryngeal tube	1.5	1
Aintree catheter	0.8	1
Gum elastic bougie	31.5	28.5
Tube changer catheter	23.3	24.4
Nasal airway	15.5	21.3
Others	13.8	

LMA: Laryngeal mask airway

the frequency of pediatric anesthesia ( $p=0.001$ ). Ownership of specially prepared kit was found 46.9% of the frequency of pediatric anesthesia every day, 30.9% of few pediatric anesthesia per week and 31.4% of few pediatric anesthesia per month.

Having encountered 1-5 cases of difficult pediatric airways, 40.8% of the participants have reported about it, while 19.2% had never observed a case. The incidence of the encounter of the pediatric difficult airway management was 50% among state hospitals, 43.7% in training and research hospitals, 30% in state universities, 26.1% in private hospitals and 22.2% in private universities.

Previous experience of the emergency surgical airway was 7.9% ( $n=31$ ) among the participants. When the regression analysis of these data was performed, the experience of specialists affected these results significantly ( $p=0.001$ ), but hospital type, course participation or age group did not ( $p > 0.05$ ).

The term CICO (can't intubate, can't oxygenate) had been previously heard by 22.8% of the participants. Results of regression analyses on familiarity with the term CICO indicated that attendance to courses, having the specialist experience and the age group of participants were significantly effective ( $p < 0.001$ ,  $p=0.002$  and  $p=0.026$ , respectively), whereas the hospital type was not ( $p=0.309$ ). Results of regression analyses on hearing of CICO term demonstrate that attendance to courses, the specialist experience and the age group of participants were significantly effective ( $p < 0.001$ ,  $p=0.002$  and  $p=0.026$ , respectively), whereas the hospital type was not effective ( $p=0.309$ ). The lowest incidence (13.8%) of hearing of the term CICO was found to be in state hospitals, while it was in the 22.2-28% range in the other types of hospitals.

In short-term pediatric surgeries, such as for an inguinal hernia, 86.7% of the participants applied general anesthesia with LMA, and 9% preferred the endotracheal tube. In 97.7% of the laparoscopic surgery cases, general anesthesia was given by the endotracheal tube and 0.8% by using the LMA, preference is for the classical LMA (62%) followed by the I-gel LMA (28.5%). Reported difficulties with the SAD which limited their use included the performance of aspiration (64.9%), intraoperative displacement (56.2%), difficulty in placement (40.5%), postoperative airway problems 16.2% and hemorrhage related trauma during removal (11.9%). Other reasons limiting SAD use comprised unavailability of the suitable number (51.7%), inability to use with ease in infants under 5 kg body weight (26.4%), and not being generally used in pediatric cases (25.6%).

Of the participants, 85.6% think that further prospective randomized studies are needed in these subjects.

## Discussion

In this study, we investigated the availability of airway equipment in pediatric anesthetic practice in Turkey. Classical LMA was most commonly used among airway equipment (95.6%). A specially prepared kit for pediatric difficult airway management was found in 35.4% of our participants. When the presence of a specially prepared kit was investigated on the basis of the hospital type and the frequency of pediatric anesthesia, significant differences were found. The survey has determined that availability of a specially kit of difficult airway equipment was high in state universities and training and research hospitals, with the highest availability being in the frequency of pediatric anesthesia every day. Only 7.9% of participants had previous emergency surgical airway experience. The rate of attendance of a course about difficult airway management was 53.1%.

In our study, the Macintosh laryngoscope, miller laryngoscope, Pro-seal LMA, and I-gel LMA were available over 40%. The McCoy laryngoscope, video laryngoscope, fiberoptic bronchoscope, cricothyroidotomy kit, tube changer catheter, and gum elastic bougie were available at 20-40%. Optical stile, combitube, laryngeal tube, FastTrack LMA, and nasal airway were available at 9-20%. Jet ventilator, retrograde intubation equipment, the newer devices (Easy laryngeal tube, and Aintree catheter) were available at less than 5%. The reasons behind this could be the high-cost and the late entry of pediatric sizes for new equipment in our country. Fiber-optic intubation remains the gold standard for intubation of the difficult airway. In the present study, 30.3% of respondents had available fiberoptic bronchoscope, and 27.9% had experience with children in this technique. SAD are frequently used in pediatric anesthesia [7]. In our study, general anesthesia with LMA in pediatric cases was preferred by 86.7% of participants in the short-term surgeries. The classical LMA being the most preferred type (62%), followed by the I-gel LMA (28.5%). Personal choice, availability, and institutional protocols may have influenced the selection of the device. In a meta-analysis using LMA during pediatric anesthesia, it is alarming that intraoperative displacement was a common problem encountered to their anesthesiologists whereas aspiration was not [8]. In our study, the difficulties of using SAD were as reported in the literature, mostly experienced during aspiration and intraoperative displacement.

Kaniyil et al. [7] reported a questionnaire survey among the anesthesiologists who participated in the National Pediatric Anesthesia Conference in 2016. The questionnaire evaluated the practice preferences of SAD in pediatric anesthesia and difficult airway management, availability of devices, and any difficulties in their usage. First-generation SAD were frequently present (97%), and 64% of the participants preferred to use it for short-term pediatric surgeries. They found that intraoperative displacement (55%) was a common problem and 11% of the participants found aspiration as a problem [7]. In our survey, the frequency of using SAD in pediatric short cases was 86.7% and the causes limiting their use were headed by the inability to do aspiration.

Calder et al. [9] conducted a survey with members of the Association of Pediatric Anesthetists of Great Britain and Ireland, European Society for Pediatric Anesthesiology, Canadian Pediatric Anesthesia Society, Society for Pediatric Anesthesia in New Zealand and Australia. They searched pediatric anesthesiologists' knowledge, experience, and confidence with the difficult airway trolley, 633 (92%) of participants defined that they had a difficult airway trolley in their theater room. They considered that training and recent use of the difficult airway trolley would increase self-assurance of the anesthetists [9]. A specially prepared kit for pediatric difficult airway management was available in 35.4% of our respondents. In the study by Calder et al. [9], a majority (35%) of the participants were treating 5 pediatric anesthesia cases per week. In the present survey, the majority of the participants (46.4%) had been administering pediatric anesthesia to few pediatric patients each week.

The Difficult Airway Society suggested a number of educational materials including a Consultant Airway Coordinator, an Airway Training Room, and special lists for airway training [5,10]. It is important that training programs realize the individual and professional significance of experiences for new physicians. Education should support the development of constructive skills through discussion and learning [11].

Among the participants of our survey 40.8% had met 1-5 difficult airway cases while 19.2% had never experienced difficult airway. Low incidences may be due to the preferred use of LMA instead of the endotracheal intubation technique in the majority of pediatric cases. In our study, 86.7% of the participants opted for LMA for short pediatric surgeries such as an inguinal hernia.

The CICO scenario is a rare but life-threatening situation in pediatric anesthesia [12]. In pediatric CICO, the Difficult Airway Society guideline suggests some airway rescue techniques [12,13]. However, pediatric CICO is very rare, and this suggestion is mostly based on animal experimental results and expert opinions [5]. Therefore, further reports are necessary to consider the best strategy for pediatric CICO [14]. The recently released the American Society of Anesthesiologists recommended cannula cricothyroidotomy for management of the CICO scenario in the increasingly hypoxic and/or bradycardic child [15]. In our survey, 23.4% of the participants had knowledge about the meaning of the CICO and it was found that the experience of airway management in pediatric surgery was 7.9%. Anesthesiologists have to identify their strategies for the CICO rescue events and should increase their experience.

Kaniyil et al. [7] reported that most of their respondents (84%) felt the need for further randomized controlled studies on the safety of SAD in children. Similarly, in our survey, 85.6% of the participants admitted the need for further studies in this subject.

Limitations of our survey include the inability to reach all anesthesiologists in our country. Thus our results on the difficult airway equipment may not reflect the entire practice. Had the survey queried the difficult mask ventilation and difficult tracheal intubation separately, more detailed data could have been obtained. Other limitations were lack of knowledge about the frequency of pediatric anesthesia annually in Turkey and the number of pediatric anesthesiologists.

As a result, an early intervention in the difficult airway is very important. Our study has emphasized the areas with the potential for international development in pediatric difficult airway management. In hospitals admitting pediatric patients, a specially prepared kit for pediatric difficult airway management must be made generally available, and the variety in equipment types should be increased. There are no magical pieces of equipment in difficult airway management. Training about difficult airway management is an ongoing process, the most important structure of patient safety is preoperative evaluation and planning. We believe that by starting training courses on pediatric difficult airway management with frequent periodicity at different centers of the country; and by widening the availability of the required equipment, experience should be advanced for increased success in difficult airway management. Repetition of training sessions at frequent intervals can improve the performance in DA management and the critical decision in CICO.

#### Scientific Responsibility Statement

*The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.*

#### Animal and human rights statement

*All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.*

#### Funding: None

#### Conflict of interest

*None of the authors received any type of financial support that could be considered potential conflict of interest regarding the manuscript or its submission.*

#### References

- Goldmann K. Recent developments in airway management of the paediatric patient. *Current Opinion in Anaesthesiology*. 2006;19:278-4.
- Cohen MM, Cameron CB, Duncan PG. Pediatric anesthesia morbidity and mortality in the perioperative period. *Anesth Analg*. 1990;70:160-7.
- Sunder RA, Haile DT, Farrell PT, Sharma A. Pediatric airway management: current practices and future directions. *Pediatr Anesth*. 2012;22:1008-15.
- Brambrink AM, Braun U. Airway management in infants and children. *Best Pract Res Clin Anaesthesiol*. 2005;19:675-97.
- Frerk C, Mitchell VS, McNarry AF, Mendonca C, Bhagrath R, Patel A, et al. Difficult Airway Society intubation guidelines working group. Difficult Airway Society 2015 guidelines for management of unanticipated difficult intubation in adults. *British Journal of Anaesthesia*. 2015;115:827-48.
- Cook TM, Woodall N, Harper J, Benger J. Fourth National Audit Project. Major complications of airway management in the UK: results of the Fourth National Audit Project of the Royal College of Anaesthetists and the Difficult Airway Society. Part 2: intensive care and emergency departments. *Br J Anaesth*. 2011;106:632-42.
- Kaniyil S, Smithamol PB, Joseph E, Krishnadas A, Ramadas KT. A survey of current practice of supraglottic airway devices in pediatric anesthesia from India. *Anesth Essays Res*. 2017;11:578-82.
- Luce V, Harkouk H, Brasher C, Michelet D, Hilly J, Maesani M, et al. Supraglottic airway devices vs. tracheal intubation in children: A quantitative meta-analysis of respiratory complications. *Pediatr Anesth*. 2014;24:1088-98.
- Calder A, Hegarty M, Davies K, Von Ungern-Sternberg BS. The difficult airway trolley in pediatric anesthesia: an international survey of experience and training. *Pediatr Anesth*. 2012;22:1150-4.
- Henderson JJ, Popat MT, Latto IP, Pearce AC, Difficult Airway Society. Difficult Airway Society guidelines for management of the unanticipated difficult intubation. *Anaesthesia*. 2004;59:675-94.
- Engel KG, Rosenthal M, Sutcliffe KM. Resident's responses to medical error: coping, learning, and change. *Acad Med*. 2006;81:86-93.
- Sabato SC, Long E. An institutional approach to the management of the 'Can't Intubate, Can't Oxygenate' emergency in children. *Pediatr Anesth*. 2016;26:784-93.
- Black AE, Flynn PE, Smith HL, Thomas ML, Wilkinson KA, Association of Pediatric Anaesthetists of Great Britain and Ireland. Development of a guideline for the management of the unanticipated difficult airway in pediatric practice. *Pediatr Anesth*. 2015;25:346-62.
- Okada Y, Ishii W, Sato N, Kotani H, Iiduka R. Management of pediatric 'cannot intubate, cannot oxygenate'. *Acute Medicine & Surgery*. 2017;4:462-6.
- Caplan R, Benumof L, Berry F. Practice guidelines for management of the difficult airway: an updated report from the American Society of Anesthesiologists task force on management of the difficult airway. *Anesthesiology*. 2003;98:1269-77.

#### How to cite this article:

Karasu D, Yilmaz C, Ozgunay SE, Karaca U. A survey of current practice of difficult airway management and equipment in pediatric anesthesia. *J Clin Anal Med* 2019; DOI: 10.4328/JCAM.6160.